

WHAT IS CLAIMED IS:

1. An apparatus for producing a volumetric display comprising:

a scanning collimated light source that creates an image by illuminating a suspension of light-scattering particles in an optically transparent medium with a collimated beam, where the brightness of the collimated beam is modulated at each moment in time by an amount that is dependent upon the momentary direction of the beam and also on the distance of the scattering particle encountered by the beam at that moment.

2. An apparatus as described in Claim 1 wherein the collimated light source is a laser.

3. An apparatus as described in Claim 2 wherein the optically transparent medium is air.

4. An apparatus as described in Claim 3 wherein the light-scattering medium is suspended dust.

5. An apparatus as described in Claim 4 wherein the light source includes rotating mirrors or resonantly vibrating mirrors, which effect the scanning or some combination of rotating mirrors or vibrating mirrors.

6. An apparatus as described in Claim 5 wherein the scanning by the light source is two-dimensional, thereby sweeping out a volumetric display region.

7. An apparatus as described in Claim 6 wherein the beam includes a first, monitoring, collimating beam used to detect the presence of the particle, and a second, illuminating, beam is used to illuminate the detected particle.

8. An apparatus as described in Claim 7 wherein the monitoring beam is outside of the visible spectrum.

9. An apparatus as described in Claim 8 wherein the spectrum is an infrared portion of the electromagnetic spectrum.

10. An apparatus as described in Claim 9 wherein the illuminating beam may vary in color.

11. An apparatus as described in Claim 10 wherein the light source includes a red, green and blue laser that produce three independently modulated contributions for color.

12. An apparatus as described in Claim 11 wherein the contributions from the red, green and blue laser are combined into a single beam path.

13. An apparatus as described in Claim 12 including a dichroic beam combiner, which combine the contributions.

14. An apparatus as described in Claim 13 including a computer memory in which a three dimensional volumetric model of illuminance is stored, and in which the direction of the beam and the distance of the particle along the beam are used to index into

this volumetric model to determine a brightness setting for the illuminating beam.

15. An apparatus as described in Claim 14 including an optical detector is used to measure the light from the monitoring beam which a particle has scattered.

16. An apparatus as described in Claim 15 wherein the optical detector measures the distance of the detected particle along the monitoring beam.

17. An apparatus as described in Claim 16 wherein the optical detector is collinear with the optical beam, so that returning light which is scattered directly back along the beam path is visible to the detector.

18. An apparatus as described in Claim 17 wherein the returning light is focused by a focusing means wherein the focusing means includes a convex lens, and measurement of the distance between the focusing device and the point of focus of the returning light is used to determine the distance along the beam of the detected particle.

19. An apparatus as described in Claim 18 wherein the light source produces scanning beams that are used to simultaneously illuminate two or more suspended particles within the same volume.

20. An apparatus for producing a volumetric display comprising:

a light source for providing light; and

means for producing a volumetric image with the light from the light source.

21. An apparatus as described in Claim 20 wherein the light source includes an infrared laser.

22. An apparatus as described in Claim 21 wherein the light source includes an infrared switchable visible-light laser.

23. An apparatus as described in Claim 22 wherein the producing means includes an optical component for merging the beams of the two lasers.

24. An apparatus as described in Claim 23 wherein the producing means includes computer control for switching the visible-light laser.

25. An apparatus as described in Claim 24 wherein the producing means includes a time-varying optical beam steering mechanism.

26. An apparatus as described in Claim 25 wherein the producing means includes computer control for time-varying optical beam steering.

27. An apparatus as described in Claim 26 wherein the producing means includes linear infrared-sensitive optical position sensor.

28. An apparatus as described in Claim 27 wherein the producing means includes suspended dust particles in the air.

29. A method for producing a volumetric display comprising the steps of:

producing light from a light source; and

producing a volumetric image with the light from the light source.